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SETAB: An Edit/Insert Program for Automatic Typesetting of Spectroscopic and Other Computerized Tables

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Contents

1.	Introduction.....	1
2.	Characteristics of SETAB.....	2
3.	Discussion of the Parameter Cards.....	4
	Sample Parameter Cards.....	5
4.	Description of the Program.....	6
	Block Diagram of SETAB.....	8
5.	Applications of SETAB.....	9
6.	Summary and Conclusions.....	15
	References.....	15
	Appendix I (Program listing).....	17
	Appendix II (Modification listing).....	23

SETAB

An Edit/Insert Program for Automatic Typesetting of Spectroscopic and other Computerized Tables by

Robert C. Thompson and Joseph Hilsenrath

SETAB is a FORTRAN program which accepts a card deck or Fortran records on magnetic tape and inserts the appropriate flags and shift symbols required by many programs associated with phototypesetting devices. The program is specialized to the particular application, the phototypesetter and typography programs, and to the desired typefaces by means of parameter cards supplied at run time. Examples are shown of spectroscopic tables typeset on the Linofilm phototypesetter at the Government Printing Office using the Autaset Typography Program. The program has also been used for tables of other types of data. The program can handle any records which can be read by a FORTRAN "READ" statement under "A" format control. The original record can be divided into as many as 40 fields and these fields can be combined in any order with any of 26 strings in front of or between the pieces. The program will, on a signal, replace a field by another field or by a combination of fields and strings. The output lines are blocked and paged via the insertion of the required strings between blocks and pages.

Keywords: Automatic typesetting; computer-assisted typesetting; edit insertion program; FORTRAN program; phototypesetting of spectroscopic tables; typesetting of tables.

1. Introduction

For years spectroscopists have been sending handwritten manuscripts to the printer to have their spectroscopic tables typeset in graphic arts quality. This was quite natural as long as all data logging and data manipulation were performed manually. With the advent of automatic data logging and the use of the computer for data reduction, the spectroscopists began to keep their data on punched cards. The appearance of phototypesetters provided a mechanism for the typesetting of machine readable data without the necessity of rekeyboarding the data.

A technique for automatic typesetting of spectroscopic tables direct from magnetic tapes was developed by W. R. Bozman in 1962. [1]. Since that time several books of data have been produced by this method. The production of each of these books entailed the preparation of special programs by a programmer experienced in machine language programming and having detailed knowledge of the operation of the Linofilm phototypesetting machine.

The design of the SETAB program was motivated by the conviction that the economic viability of computer-assisted typesetting rested on the use of general-purpose rather than special-purpose programs. That this is indeed the case, has been born out by experience with a number of applications that are discussed in this paper.

In an earlier report, [2] McClenon and Hilsenrath have shown that the FORTRAN program REFORM can be used to insert the flags required by the typography programs. However, REFORM lacks a number of features desirable in a generalized edit/insertion program for phototypesetting of tables. Therefore, the program SETAB, described in this report, was written incorporating many of the features of REFORM and containing a number of additional features desired for an edit/insert program.

While the magnetic tapes produced by Bozman had the codes required to drive the photounit directly, SETAB produces tapes which need to be processed by a typography program before the material can be set. It is, however, a feature of SETAB that it can insert any required flags. It is therefore not restricted to a particular typography program or to a particular typesetting machine. The specific flags are supplied at run time.

Except for two READ statements (500,510), the program is written in a subset of ANSI FORTRAN. No logical statements are used, since the format of these deviates from the standard on some computers. Particular care was taken to make it machine independent with respect to internal bit configuration and as system independent as possible. The logical unit numbers designating the system card reader, printer, card punch and tape drives differ not only from machine to machine, but also from installation to installation. Therefore some changes will probably be necessary if this program is to be used at any other installation. In order to minimize the modifications required in implementation, the input and output devices are designated by variables which are defined at the beginning of the program.

2. Characteristics of SETAB

The program discussed here operates on a fixed field file consisting of cards, card images or Fortran records on a magnetic tape, and produces a magnetic tape suitable for input to typography programs such as those used by the Government Printing Office. The program, suitably instructed via parameter cards, divides the original record into as many as 40 fields and then combines these fields in the specified order with up to 26 strings. These strings can be typesetting flags such as locators to be put at the beginnings of lines or columns, or a grid change flag to set a particular column in boldface or italics.

Since a field can be defined as a single character, it is possible to make a character, a subscript or a superscript by bracketing it with the required typesetting flags. It is also possible to add information that is not in the input data stream if the information is to appear in the same place in every typeset line. Also, card decks often have blank cards between blocks of data, and computer listings often have blank lines between blocks. When that information is typeset the blank line between blocks is usually of a different spacing than the spaces between normal data lines. To accomodate this the program deletes all blank cards or lines and inserts specified typesetting flags after each block of a specified number of lines and after each page of a specified length. There are times when a character in the input is not the character that is desired in the typeset copy. To cope with this, the program can be instructed to replace one character by another in a specified portion of the record.

The over-all format of an output line is controlled by a parameter card that designates the order of the fields and the strings, if any, to be inserted. The latter control the typography and may even insert information which was not contained in the original record. However, there are times when the way the information in a given field is to be printed depends not only on its position but also on its content. An example of the need for handling information in a designated field differently depending on the content of a portion of that field is shown in figure 1. Here the information in the classification column is handled quite differently from line to line depending upon whether the character in position 44 is numeric or alphabetic.

TABLE 3. *Observed and classified lines of W 1*

Wavelength Å	Intensity		Wavenumber (cm ⁻¹)		Classification
	Arc	Spark	Observed	o - c	
2746.734	40		36396.11	+0.02	15 ₃ — 518 ₄ [°]
2747.005	50	2	36392.52	+0.06	³ P ₁ — 496 ₂ [°]
2747.155	15	3	36390.54		
2747.826	40	2	36381.65	-0.21	⁵ D ₄ — 426 ₃ [°]
				+0.16	⁵ D ₂ — 397 ₂ [°]
2748.312	20	15 s	36375.21	-0.04	³ G ₄ — 528 ₃ [°]
2748.577	30	3	36371.71	+0.02	18 ₃ — 553 ₄ [°]
2748.767	5		36369.20	-0.10	20 ₂ — 573 ₃ [°]
2748.844	80	20	36368.17	+0.03	⁵ D ₃ — 411 ₄ [°]
2748.997	25	2	36366.15	+0.15	19 ₂ — 556 ₂ [°]
2749.538	1	2	36359.01		
2749.641	10		36357.65		
2750.145	40	4	36350.98	-0.02	³ G ₃ — 496 ₂ [°]
2750.325	10	20 s	36348.60	+0.01	19826 ₅ — 561 ₄ [°]
2750.444	10		36347.03	+0.08	19 ₃ — 561 ₄ [°]
2746.734	40		36396.11	+0.02	153 - 51840
2747.005	50	2	36392.52	+0.06	3P1 - 49620
2747.155	15	3	36390.54		
2747.826	40	2	36381.65	-0.21	5D4 - 42630
				+0.16	5D2 - 39720
2748.312	20	15S	36375.21	-0.04	3G4 - 52830
2748.577	30	3	36371.71	+0.02	183 - 55340
2748.767	5		36369.20	-0.10	202 - 57330
2748.844	80	20	36368.17	+0.03	5D3 - 41140
2748.997	25	2	36366.15	+0.15	192 - 55620
2749.538	1	2	36359.01		
					⁵ D ₂ — 396 ₃ [°]
					22852 ₄ — 591 ₄ [°]

Figure 1. A portion of a spectroscopic table phototypeset from information supplied on ordinary punched cards. Note how differently the lines containing pure numerics are treated from those that contain mixtures of letters and numbers.

3. Discussion of the Parameter Cards

A partial listing of the parameter cards for one run is shown in figure 2. A number of the cards were removed to permit one of each type of parameter card to be shown in a single figure. The first card contains the alphabet, beginning with A in column 1 and the digits starting with zero in column 27. Column 47 must be blank and column 80 contains the character used as a string delimiter.

The second card contains the following parameters in I3 format.

1. The number of fields in the input record
2. The length of the input record
3. The number of lines in an output block
4. The number of lines on an output page (This must be an integral number of blocks)
5. The input unit number
6. The output tape unit number
7. The output print switch; = 0 for a printer copy of the output, = 1 for only writing an output tape
8. The EOF switch;=0 for an end of file to be written at end of output file, =1 if no EOF is to be written
9. The input tape rewind switch; = 0 for tape to be rewound before reading, = 1 if input tape is not to be rewound
10. The output tape rewind switch. =0 for tape to be rewound before writing =1 if not

The last three fields are normally left blank or set equal to zero. These switches were provided to permit the processing of several input files into one output file.

The third parameter card contains the character stream required to achieve the spacing desired between blocks. The fourth card contains the character stream which is desired to be placed at the end of each page. The fifth card contains the line to be printed at the end of the table.

The sixth card, in 26I3 format, gives the beginnings and lengths of the input fields in pairs. Columns 1-3 contain the character or column number that begins the first field. Columns 4-6 contain the number of characters in the first field. Columns 7-9 contain the character or column number that begins the second field, and so forth. If more than 13 fields are desired, they are put on another card. A maximum of 40 fields can be specified. The input record cannot exceed 132 characters.

The seventh card, in 26 (I2,A1) format, specifies the makeup of the output. If the output is to begin with a string, columns 1 and 2 can be left blank or made zero. However, if any other pair of columns that would specify a field number is blank or if the field number is zero, this is taken as the end of the output record specification and no more fields or strings are put into the output record.

The eighth and succeeding cards contain the strings to be inserted between fields of the input. Each string is terminated by the character in column 80 of the first parameter card. The last card is to have the character in column 1. This terminates the reading of strings. Only 26 strings are permitted. The strings are automatically assigned names, which are the letters of the alphabet in order.

The next set of cards contains the fields and characters for the single character substitution. The cards are in 4I3 format. The first field (columns 1-3) contains the column number where the substitution is to start.

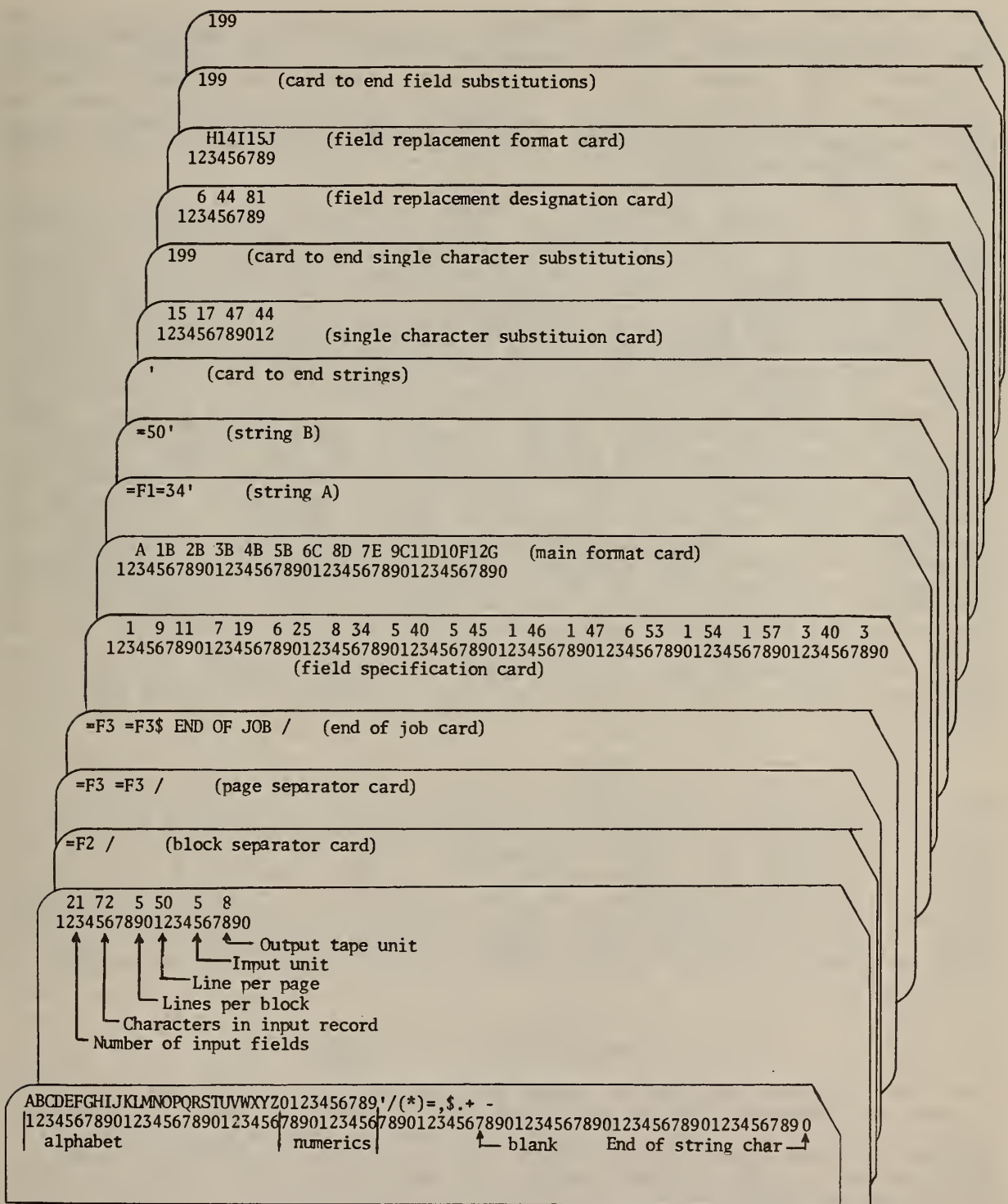


Figure 2. Sample Parameter Cards - A sampling of the parameter cards required for a run, showing at least one of each type used. The numbers on the second line of some of the cards are put there to show the position for fixed field input.

The second field (columns 4-6) contains the column number of the last column for this substitution. The third field (columns 7-9) is the character code (the card column from the first parameter card) of the character to be replaced. The fourth field is the character code of the character that is to replace the original character. The last card of the set must have the number 199 in the first field. This signals the end of this set of cards. Only 25 cards are allowed in this set unless the dimensions of IBST, IBEN, LCAR, and LREP are changed.

The next cards contain, in pairs of cards, the changes in output desired in up to 30 different fields. The first card of the pair, in 3I3 format, contains: in columns 1-3, the field to be replaced; in columns 4-6, the input card column in which the flag character is to be found; in columns 7-9, the column of the first parameter card that contains the character that is to act as a flag signaling the change in format. The second card of the pair contains the strings and fields to replace the given field. This card has the same format as the seventh parameter card which specified the normal output. A maximum of 30 fields may be substituted for. The last card of this set must have the number 199 in columns 1-3. If the column number given for the flag character is 80 or less, it designates the character in that card column of the first parameter card. If the number is 81 it designates that the flag character is one of the characters in columns 1-26 of the first parameter card, i.e., any alphabetic character. The number 82 designates that the flag character is numeric (column 27-36 of the first parameter card). 83 designates any graphic character (not a character in columns 1-36 of the first parameter card). 84 designates any nonalphabetic character (not in columns 1-26 of first parameter card). 85 designates any non-numeric character (not in columns 27-36 of first parameter card). 86 designates any non-graphic character (any character in columns 1-36 of the first parameter card). The same character on input can be used to signal changes in output for more than one field. The last card of this set shall have the number 199 in the first field signaling the end of the set of cards.

The last card, in 4I3 format, specifies the condition that signals when the counter containing the number of lines processed is to be reset. When the card contains the number 199 in columns one to three, the program will insert the characters required to start a new page on the basis of the line count in accord with the instructions given on card two. When it is desirable to start a new page on the basis of the content of a line, it is done by matching characters in the input to one of the ad hoc strings. Columns 1-3 specify the beginning character number, columns 4-6 specify the final character to be matched, columns 7-9 specify the number of the string to be matched, and columns 10-12 contain the number to which the counter is to be reset.

4. Description of the Program

The program consists of a main program with no subroutines. There are a number of comment cards at the beginning that explain how the parameter cards are to be prepared. In order to minimize changes when adapting this program to other installations, the input and output instructions reference the variables: ITAPE, IOTAPE, IRTAPE, and IPTAPE. The latter two are defined via parameter cards input at the beginning of the program. In the listing of the program accompanying this report, ITAPE is equated to logical unit 5 which is the card reader, IOTAPE is equated to .6 which is the printer, IRTAPE may have a default value of 5, and IPTAPE may have a default value of 3 specifying the card punch. The last two are normally specified on the second parameter card, and only if the units specified are obviously incorrect are the default values used. In installations where these peripherals have different numbers, the nine statements (cards 790-870)

which check whether they have been correctly specified would have to be changed. The first executable statements define ITAPE as the card reader and IOTAPE as the printer.

A block diagram of the program is shown in figure 3. The first parameter card serves to define the punch configuration for the characters on the data and parameter cards. The presence of the characters on the first card obviates the need to define them explicitly in the program. This simple device makes the program independent of a variety of incompatibilities which are often such a source of trouble in adapting programs to different computers. The program logic uses the disposition of the characters on the first parameter card in such a way as to avoid entirely the need to know how a particular machine recognizes a character on a card, what the internal bit representation of that character is, and where that character is placed in a machine word. In this way the program is independent of whether the particular machine stores away 3 characters per machine word, or 6 or even 7. Nor is it dependent on whether a single character is stored left-adjusted, right-adjusted or in any other way. The second card specifies the input and output parameters. The program checks the values supplied for the input and output units to see if they are reasonable and, if not, assigns default values. The strings to be inserted between blocks and pages and at the end of the file are read into buffers. The beginning and length of the fragments on the input record are defined. Then the normal output format card is read, and the fields are checked to see that they were specified. The strings are then read into a buffer, and the lengths of the strings are determined and stored. After reading the cards specifying the single character substitutions, the field replacements and the new page signal, the program is ready to process the input.

First a record is read into buffer IB in 132A1 format. If the record is a blank line a new record is read in. The record is checked to see if it has a flag signaling a change in paging. If the flag is found the line counter is reset to the value specified. The single character substitution is performed next.

The program is now ready to start building a new record in buffer IBUFR, from pieces of the input record and the strings. The first number on the output format card is checked, and the specified piece of the input buffer IB is moved into IBUFR. If the first number is zero the program skips down to the next step. Then the program checks the alphabetic character to determine which string is to be transferred, and the specified string is moved to IBUFR. If the alphabetic character is a blank no string is moved. The program then checks to see if the next field number is zero or blank, if it is, this signals that the record is complete. If the next field number is one that is sometimes replaced by a different field or combination of fields and strings, the program checks the flag character. If the field is to be replaced, the program moves the appropriate fields and strings into IBUFR, otherwise it moves the specified field in. Then the program places the next string into IBUFR and checks to see if the next field number is zero or blank signaling that the record is complete.

If the record is complete, it is written out on tape, and if the print switch (ITEST) is nonzero the record is also written on the printer. The line counter is advanced by one. The counter is then checked to see if the record was the last of a block. If it was, the counter is checked to see if the line was the last line on the page. If the line was the end of a page or a block the appropriate string is written on the output tape. Then the program reads in a new record.

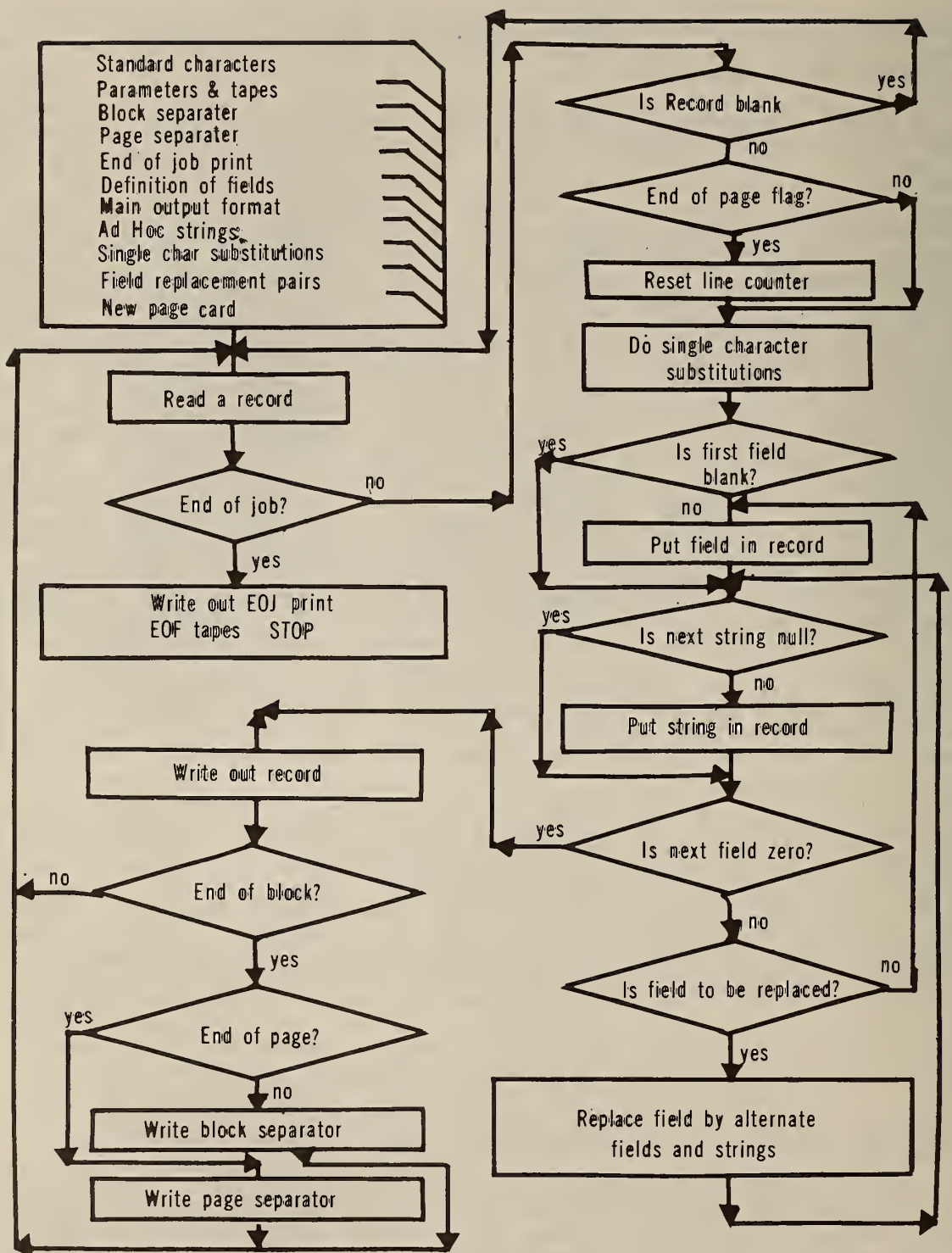


Figure 3. Block diagram of SETAB.

5. Applications of SETAB

An example of a simple table in a NSRDS publication [3] typeset by using this program is shown in figure 4. The parameter cards and the data cards for this portion of the table are shown in figure 5. The output of the program is shown in figure 6. The program, following the instructions on the format card, has put =F1 at the beginning of each line of data. This was used as the format flag for the Autoset Typography Program at the Government Printing Office. It serves to select the desired typeface, point size and leading (space between lines). The =40 causes 40 units of space to be set between columns. The slash at the end of each line is the end of record character. Between each block of five lines the character string =F2=P1./ is defined to put the desired quad line between blocks. There is nothing in the output to instruct the phototypesetting machine how to set the column headings. This program does not have provision for table headings, column headings, or rules. We prefer to have these set only one time and then put on the table as an overlay.

TABLE 2. *Thermodynamic Functions for Copper*

Gram atomic wt.=63.5400, $T^{\circ}\text{K}=273.15+t^{\circ}\text{C}$, 1 cal=4.1840J

T	C_p°	$H_f^{\circ}-H_0^{\circ}$	$(H_f^{\circ}-H_0^{\circ})/T$	S_f°	$-(G_f^{\circ}-H_0^{\circ})$	$-(G_f^{\circ}-H_0^{\circ})/T$
$^{\circ}\text{K}$	J/deg-mol	J/mol	J/deg-mol	J/deg-mol	J/mol	J/deg-mol
1.00	0.000743	0.000359	0.000359	0.000711	0.000351	0.000351
2.00	0.00177	0.00158	0.000790	0.00152	0.00145	0.000727
3.00	0.00337	0.00409	0.00136	0.00251	0.00345	0.00115
4.00	0.00582	0.00860	0.00215	0.00379	0.00657	0.00164
5.00	0.00943	0.0161	0.00322	0.00546	0.0112	0.00223
6.00	0.0145	0.0279	0.00466	0.00760	0.0176	0.00294
7.00	0.0213	0.0456	0.00652	0.0103	0.0265	0.00379
8.00	0.0301	0.0712	0.00889	0.0137	0.0385	0.00481
9.00	0.0414	0.107	0.0119	0.0179	0.0542	0.00602
10.00	0.0555	0.155	0.0155	0.0229	0.0746	0.00746
11.00	0.0727	0.219	0.0199	0.0290	0.100	0.00913
12.00	0.0936	0.302	0.0251	0.0362	0.133	0.0111
13.00	0.119	0.407	0.0313	0.0447	0.173	0.0133
14.00	0.149	0.541	0.0386	0.0545	0.223	0.0159
15.00	0.184	0.706	0.0471	0.0660	0.283	0.0189
16.00	0.225	0.910	0.0569	0.0791	0.355	0.0222
17.00	0.273	1.158	0.0681	0.0941	0.442	0.0260
18.00	0.328	1.458	0.0810	0.111	0.544	0.0302
19.00	0.390	1.816	0.0956	0.131	0.665	0.0350
20.00	0.462	2.242	0.112	0.152	0.806	0.0403
25.00	0.963	5.703	0.228	0.305	1.917	0.0767
30.00	1.693	12.25	0.408	0.541	3.995	0.133
35.00	2.638	22.99	0.657	0.871	7.487	0.214
40.00	3.740	38.89	0.972	1.294	12.86	0.322
45.00	4.928	60.54	1.345	1.802	20.57	0.457
50.00	6.154	88.23	1.765	2.385	31.01	0.620
55.00	7.385	122.1	2.220	3.029	44.52	0.809
60.00	8.595	162.0	2.701	3.724	61.38	1.023
65.00	9.759	208.0	3.199	4.458	81.82	1.259
70.00	10.86	259.5	3.708	5.222	106.0	1.514

Figure 4. A portion of Table 2 of NSRDS-NBS-18 which was set on the Linofilm phototypesetter from punched cards using SETAB to insert the flags required by the Autoset Typography Program at the Government Printing Office. The rules and headings were supplied with overlays.

ABCDEFGHIJKLMN OPQRSTUVWXYZ0123456789'(*),=,\$.+

\$

7 72 5 50 5 7 0 1

=F2 =P /

=F3 =P /

=F4 =P /

2 6 9 9 20 11 32 9 42 9 52 11 64 9

A 1B 2B 3B 4B 5B 6B 7C

=F1\$

=40\$

/ \$

\$

199

199

199

1.00	0.000743	0.000359	0.000359	0.000711	0.000351	0.000351CU	JOULE
2.00	0.00177	0.00158	0.000790	0.00152	0.00145	0.000727CU	JOULE
3.00	0.00337	0.00409	0.00136	0.00251	0.00345	0.00115 CU	JOULE
4.00	0.00582	0.00860	0.00215	0.00379	0.00657	0.00164 CU	JOULE
5.00	0.00943	0.0161	0.00322	0.00546	0.0112	0.00223 CU	JOULE
6.00	0.0145	0.0279	0.00466	0.00760	0.0176	0.00294 CU	JOULE
7.00	0.0213	0.0456	0.00652	0.0103	0.0265	0.00379 CU	JOULE
8.00	0.0301	0.0712	0.00889	0.0137	0.0385	0.00481 CU	JOULE
9.00	0.0414	0.107	0.0119	0.0179	0.0542	0.00602 CU	JOULE
10.00	0.0555	0.155	0.0155	0.0229	0.0746	0.00746 CU	JOULE
11.00	0.0727	0.219	0.0199	0.0290	0.100	0.00913 CU	JOULE
12.00	0.0936	0.302	0.0251	0.0362	0.133	0.0111 CU	JOULE

Figure 5. The parameter cards and a portion of the data cards input to SETAB to produce the table shown in Figure 4. Note that the text in columns 73-80 of the original file is ignored by defining the input record to extend only to 72 characters. Had these comments appeared between the desired data, they could have been ignored in the same manner that the blanks are ignored in the field definition card.

```
=F1 1.00=40 0.000743=40 0.000359=40 0.000359=40 0.000711=40 0.000351=40 0.000351 /
=F1 2.00=40 0.00177 =40 0.00158 =40 0.000790=40 0.00152 =40 0.00145 =40 0.000727 /
=F1 3.00=40 0.00337 =40 0.00409 =40 0.00136 =40 0.00251 =40 0.00345 =40 0.00115 /
=F1 4.00=40 0.00582 =40 0.00860 =40 0.00215 =40 0.00379 =40 0.00657 =40 0.00164 /
=F1 5.00=40 0.00943 =40 0.0161 =40 0.00322 =40 0.00546 =40 0.0112 =40 0.00223 /
=F2 =P /
=F1 6.00=40 0.0145 =40 0.0279 =40 0.00466 =40 0.00760 =40 0.0176 =40 0.00294 /
=F1 7.00=40 0.0213 =40 0.0456 =40 0.00652 =40 0.0103 =40 0.0265 =40 0.00379 /
=F1 8.00=40 0.0301 =40 0.0712 =40 0.00889 =40 0.0137 =40 0.0385 =40 0.00481 /
=F1 9.00=40 0.0414 =40 0.107 =40 0.0119 =40 0.0179 =40 0.0542 =40 0.00602 /
=F1 10.00=40 0.0555 =40 0.155 =40 0.0155 =40 0.0229 =40 0.0746 =40 0.00746 /
=F2 =P /
=F1 11.00=40 0.0727 =40 0.219 =40 0.0199 =40 0.0290 =40 0.100 =40 0.00913 /
=F1 12.00=40 0.0936 =40 0.302 =40 0.0251 =40 0.0362 =40 0.133 =40 0.0111 /
=F1 13.00=40 0.0119 =40 0.407 =40 0.0313 =40 0.0447 =40 0.173 =40 0.0133 /
=F1 14.00=40 0.0149 =40 0.541 =40 0.0386 =40 0.0545 =40 0.223 =40 0.0159 /
=F1 15.00=40 0.0184 =40 0.706 =40 0.0471 =40 0.0660 =40 0.283 =40 0.0189 /
=F2 =P /
```

Figure 6. The output of SETAB resulting from the input shown in Figure 5. This was processed by the Autoset Typography Program at the Government Printing Office and run on the Linofilm Phototypesetter to produce the results shown in Figure 4. The character inserted by SETAB serve the following functions =F1 is a format flag which serves to select the type face, the point size and loading the sequence' =F2 =P / provides for an appropriate space between the data blocks. =40 introduces 40 units of space between the columns. The slash acts as an end of record symbol.

[illegible]

```

!F1 2746.734!51 40$$$145 $$$!5236396.11!58+0.02!56 15!G2$!G33!G1- 518!G20!G34!60!G4 /
!F1 2747.005!51 50$$$145 2$$$!5236392.52!58+0.06!56!25!G23!G1(P)!G2$!G31!G1- 496!G20!G32!60!G4 /
!F1 2747.155!51 15$$$145 3$$$!5236390.54!158# / !56 !C2$!G3$!G1 !G2$!G3$!60!G4 /
!F1 2747.826!51 40$$$145 2$$$!5236381.65!58-0.21!56!25!G25!G1(D)!G2$!G34!G1- 426!G20!G33!60!G4 /
!F1178!51!72!45!63!52!69!58+0.16!56!25!G25!G1(D)!G2$!G32!G1- 397!G20!G32!60!G4 /
!F2 !P /
!F1 2748.312!51 20$$$145 15$$$!5236375.21!58-0.04!56!25!G23!G1(G)!G2$!G34!G1- 528!G20!G33!60!G4 /
!F1 2748.577!51 30$$$145 3$$$!523637!7.71!58+0.02!56 18!G2$!G33!G1- 553!G20!G34!60!G4 /
!F1 2748.767!51 5$$$145 $$$!5236369.20!58-0.10!56 20!G2$!G32!G1- 573!G20!G33!60!G4 /
!F1 2748.844!51 80$$$145 20$$$!5236368.17!58+0.03!56!25!G25!G1(D)!G2$!G33!G1- 411!G20!G34!60!G4 /
!F1 2748.997!51 25$$$145 2$$$!5236366.15!58+0.15!56 19!G2$!G32!G1- 556!G20!G32!60!G4 /
!F2 !P /

```

11

```

ABCDEFGHIJKLMNPOQRSTUVWXYZ0123456789'/(*)=,$.+ - S #
22 72 5 50 5 8
!F2 !P / BLOCK SEPARATOR
!F3 !F3 !F3 !P / PAGE SEPARATOR
!F3 !P / END OF TABLE
1 9 11 7 19 6 25 8 34 5 40 5 45 1 46 1 47 6 53 1 54 1 57 3 40 3
43 1 44 1 47 1 51 1 52 1 57 1 50 1 59 1 58 1
A 1B 2C 3D 4E 5F 6G 8H 7I 9G11H10J12K
!F1' STRING A LOCATOR TO BEGIN LINE
!51' STRING B SPACE BETWEEN COLS. 1 AND 2
!45' STRING C SPACE BETWEEN COLS. 2 AND 3
!52' STRING D SPACE BETWEEN COLS. 3 AND 4
!58' STRING E SPACE BETWEEN COLS. 5 AND 6
!56' STRING F SPACE BETWEEN COLS. 7 AND 8
!G2' STRING G SUPERSCRIPT GRID FLAG
!G3' STRING H SUBSCRIPT GRID FLAG
!G1' STRING I NORMAL GRID FLAG
!60!G4 STRING J
/' STRING K END OF STRING SYMBOL
!G1' STRING L
( STRING M LOWER CASE SHIFT SYMBOL
) STRING N UPPER CASE SHIFT SYMBOL
!25!G2' STRING O
!25!G2' STRING P
!16' STRING Q
!78' STRING R WIDTH OF COLUMN 1
!72' STRING S WIDTH OF COLUMN 2
!63' STRING T WIDTH OF COLUMN 3
!69' STRING U WIDTH OF COLUMN 4
' END OF STRINGS!
15 17 47 50 IN COLS 15 THRU 18 REPLACE A BLANK (47) BY A $ (50)
22 24 47 50
36 36 47 50 IN COL 36 REPLACE A BLANK (47) BY A / (38)
45 46 47 50
53 54 47 50
34 34 47 60
199 END OF CHARACTER REPLACEMENT CARDS
1 6 47 REPLACE FIELD 1 IF COL 6 IS BLANK
R BY STRING R
2 6 47 REPLACE FIELD 2 IF COL 6 IS BLANK
S BY STRING S
3 6 47 REPLACE FIELD 3 IF COL 6 IS BLANK
T BY STRING T
4 6 47
U
* [ 6 44 81 REPLACE FIELD 6 BY THE FOLLOWING IF COL 44 IS ALPHABETIC
* [ P14L15M
9 52 81 REPLACE FIELD 9 BY THE FOLLOWING IF COL 52 IS ALPHABETIC
16Q20G17L18M
12 57 18
N19M22
199
199

```

Figure 9. The parameter cards used with SETAB to produce the output shown in figure 8. The bracketed pair of field replacement cards are the ones that permit the typographic variation between lines in the classification column in figure 1. The grey area contains comments which the program ignores.

An example of a different spectroscopic table from a paper by Sugar [6] is shown in figure 10. The parameter cards input to SETAB are shown in figure 11. Note that J values in the classification column are given as integers in columns 33 and 42 with an added 1/2 being implied. It was possible to change the integers to fractions by making use of the field replacement feature of the program. The J value is defined as a separate field. The string !G3 inserted before the J value calls up the subscript grid. Then pairs of field replacement cards are used to replace the integers by the required fractions. Field 7 is a single character in position 33. The bracketed pair of field replacement cards replace a 2 by 5/2. The first card of the pair can be read as: Replace Field 7, if the character in position 33 is a 2 (designated as character 29), by the strings and fields specified on the next card. The second card of the pair specifies the replacement format as string M, which is 5/2. Ten sets of cards are required to handle the ten possible digits which define the J values in one field. Since this is done for two fields, a total of forty cards are required for this purpose.

λ_{air} Å	Intensity	σ (cm ⁻¹)	Classification
3011.282	20 * v	33198.77	50227 _{5/2} - 83426° _{5/2}
3006.469	60 * r	33251.92	38726 _{7/2} - 71978° _{7/2}
3004.002	10 * r	33279.22	52026 _{3/2} - 85306° _{5/2}
3002.106	2	33300.24	38694 _{5/2} - 71994° _{5/2}
2982.236	9 * r	33522.11	45844 _{3/2} - 79366° _{5/2}
2980.583	5 * r	33540.70	50869 _{1/2} - 84409° _{3/2}
2978.907	9 * v	33559.57	45807 _{5/2} - 79366° _{5/2}
2976.347	40 * v	33588.43	45807 _{5/2} - 79395° _{7/2}
2963.032	2	33739.36	36642 _{13/2} - 70381° _{13/2}

3011.282	20*v	33198.77	50227	2-	8342602
3006.469	60*R	33251.92	38726	3-	7197803
3004.002	10*R	33279.22	52026	1-	8530602
3002.106	2	33300.24	38694	2-	7199402
2982.236	9*R	33522.11	45844	1-	7936602
2980.607	5C	33540.42	50869	0-	8440901
2980.583	5*R	33540.70	50869	0-	8440901
2978.907	9*v	33559.57	45807	2-	7936602
2976.347	40*v	33588.43	45807	2-	7939503
2963.032	2	33739.36	36642	6-	7038106
2940.896	7*v	33993.30	51312	2-	8530602
2933.827	1	34075.21	37919	3-	7199402
2930.192	50*v	34117.48	35291	4-	6940805
2924.661	2*v	34181.99	50227	1-	8440901
2910.612	70*v	34346.98	28885	4-	6323203

Figure 10. A portion of a table phototypeset using SETAB as the Edit/Insertion program to transform the records shown as an insert. Note that the character before the dash is an integer. Each of the integers in this position is replaced by a fraction as follows: 2 becomes 5/2, 3 becomes 7/2 etc. This table was set in 8 point type in galley form and pasted up into 2 columns. The rules and column headings were stripped in manually.

ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789'/(*)=,\$.+ - \$

%

11 72 5 55 7 8

!F1 !P %

BLOCK SEPARATOR

!F1 !F1 !F1 !F1 !P %

PAGE SEPARATOR

!F1 !F1 !F1 !F1 !F1>E<ND OF JOB %

END OF TABLE

2 8 11 4 15 2 18 9 27 5 32 1 33 1 34 7 41 1 42 1 16 1

A 1B 2 3C 4V 5D 6E 7F 8D 9E10G

!F1'	STRING A	LOCATOR TO BEGIN LINE
!45'	STRING B	SPACE BETWEEN COLS. 1 AND 2
!45'	STRING C	SPACE BETWEEN COLS.2 AND 3
!G2>'	STRING D	SUPERSCRIT GRID FLAG
!G3<'	STRING E	SUBSCRIPT GRID FLAG
!G1<'	STRING F	NORMAL GRID FLAG
% '	STRING G	END OF LINE SYMBOL
!68'	STRING H	WIDTH OF COLUMN 1
!36'	STRING I	WIDTH OF COLUMN 2
!77'	STRING J	WIDTH OF COLUMN 3
1>/<2\$'	STRING K	REPLACES 0
3>/<2\$'	STRING L	REPLACES 1
5>/<2\$'	STRING M	REPLACES 2
7>/<2\$'	STRING N	REPLACES 3
9>/<2\$'	STRING O	REPLACES 4
11>/<2'	STRING P	REPLACES 5
13>/<2'	STRING Q	REPLACES 6
15>/<2'	STRING R	REPLACES 7
17>/<2'	STRING S	REPLACES 8
19>/<2'	STRING T	REPLACES 9
!G4>-<!G1'	STRING U	
!54'	STRING V	

END OF STRINGS

IN COLS 15-16 REPLACE A BLANK(47) BY A \$(50)

IN COL 31 REPLACE A BLANK(47) BY A #(65)

IN COL 32 REPLACE A 0(15) BY A ,(43)

IN COL 32 REPLACE A 0(27) BY A ,(43)

15 16 47 50
31 31 47 65
32 32 15 43
32 32 27 43
32 32 47 50
41 41 15 43
41 41 27 43
41 41 47 50

199

END OF CHARACTER REPLACEMENT CARDS

REPLACE FIELD 1 IF COL 1 IS A *(40)

BY STRING H (WIDTH OF COL 1)

1 1 40

H

2 1 40

I

3 15 40

U11

4 1 40

J

7 33 27

K

7 33 28

L

7 33 29

M

REPLACE FIELD 3 IF COL 15 IS A *(40)

BY STRING U, FIELD 11

REPLACE FIELD 7 IF COL 33 IS A 0(27)

BY STRING K(1/2)

REPLACE FIELD 7 IF COL 33 IS A 2(29)

BY STRING M(5/2)

ETC.

199

END OF FIELD REPLACEMENT CARDS

199

LAST PARAMETER CARD

Figure 11. The parameter cards used with SETAB to produce the output shown in figure 10. The bracketed pair of field replacement cards are the ones that permit phototypesetting a 5/2 for the 2 before the dash on the first line.

6. Summary and Conclusions

SETAB is a general-purpose program written in ANSI FORTRAN that inserts into a character stream, symbol sequences required by typography programs at the U.S. Government Printing Office. This program permits any computer user to prepare a magnetic tape for phototypesetting of spectroscopic and other tables from fixed field records. The generality of the program arises from the fact that all of the typographic instructions are supplied in the form of parameter cards which are external to the program. The use of this program makes it economical to produce tables with complex spectroscopic notation for tables as short as 10 pages or less. The program is listed in Appendix I. The examples used in this report are from jobs run through an old 1401 Autaset program. Since then the G. P. O. has changed the computer as well as the typesetting programs, and the typesetting flags they recognize. In spite of these substantive changes in the typesetting programs, the SETAB program described here did not need to be rewritten, because the typographic instructions are carried on the control cards. For example, the present method uses the string !I01 instead of !F1. Similarly the string !P is no longer used at the end of the strings used to denote block separators, page separators, etc.

The program listed in Appendix I produces an output tape containing a separate record for each line to be printed. Now that the Typography programs at the Government Printing Office have large input buffers they request blocked records. The modification used at NBS is listed in Appendix II. It was not written in ANSI FORTRAN because the NBS computer can not write FORTRAN records longer than 132 characters.

References

- [1] William R. Bozman, "Phototypesetting of Computer Output", Nat. Bur. Stand. (U.S.), Tech. Note 170 (June 1962). Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
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- [3] George T. Furukawa, William Saba, and Martin L. Reilly, "Critical Analysis of Heat-Capacity Data of the Literature and Evaluation of Thermodynamic Properties of Copper, Silver and Gold from 0 to 300°K", Nat. Stand. Ref. Data Ser. Nat. Bur. Stand. (U.S.), 18 (Apr. 1968). Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
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- [5] Jack Sugar, "The Third Spectrum of Praseodymium (Pr III) in the Vacuum Ultraviolet", J. Res. Nat. Bur. Stand. (U.S.), 73A (Phys. and Chem.) No. 3 (May - June 1969)

APPENDIX I

The program as listed here was written to permit easy implementation on various computers and compilers of different vintage. If it is desired to block the output, modifications must be made. The markings to the right of the listings indicate which lines of the program were replaced by correspondingly marked lines in APPENDIX II to provide blocked output from the NBS computer. The < means insert and the dot and brace denote lines to be replaced by corresponding sections in APPENDIX II.

	SETAB	STB	
C		10	
C		20	
C	THIS PROGRAM WAS WRITTEN BY R.C.THOMPSON NBS NSRDS IN AUGUST 1968.	30	
C	IT IS A EXPANSION OF CTGPO WRITTEN BY R.C.THOMPSON IN DECEMBER OF 67	40	
C	IT CAN BE USED TO REFORMAT TABLES IN GALLY FORMAT INTO GPO FORMAT.	50	
C	THE PROGRAM DIVIDES THE CARD OR LINE INTO A MAXIMUM OF 40 FIELDS. THE	60	
C	NEW LINE IS COMPOSED OF THESE FIELDS REARRANGED IN ANY ORDER WITH	70	
C	AD HOC STRINGS ADDED BETWEEN THE FIELDS. SINGLE CHARACTER SUBSTITUTION	80	
C	MAY BE PERFORMED ON ANY RUN OF COLUMNS. USING A COL AS A FLAG A FIELD	90	
C	MAY BE REPLACED BY A LIST OF STRINGS AND FIELDS.	100	
C	THE FIRST CONTROL CARD CONTAINS THE LIST OF CHARACTERS WITH THE	110	
C	LETTER A IN COL 1, B IN COL 2, ET SEQ. THE NUMBERS FOLLOW WITH ZERO	120	
C	IN COL 27 ET SEQ. COL 47 IS BLANK AND COL 80 HAS THE CHARACTER USED	130	
C	TO END THE STRINGS.	140	• A
C	THE SECOND CARD IS IN 26I3 FORMAT, ALL NUMBERS TO BE RIGHT ADJUSTED	150	
C	COLS 1-3 IS THE NUMBER OF FIELDS TO DIVIDE THE INPUT RECORD INTO,	160	
C	4-6 LENGTH OF INPUT RECORD, 7-9 IS NUMBER OF LINES IN A BLOCK, 13-12	170	
C	IS THE NUMBER OF LINES ON A PAGE, 13-15 IS THE INPUT TAPE UNIT, IF	180	
C	THIS FIELD IS 0 OR BLANK A DEFAULT NUMBER OF 5 DESIGNATING THE CARD	190	
C	READER IS USED. 16-18 IS THE OUTPUT TAPE NUMBER, A DEFAULT NUMBER OF	200	
C	3 DESIGNATES THE CARD PUNCH. 19-21 IS 1 IF A COPY OF THE OUTPUT ON	210	
C	THE PRINTER IS NOT DESIRED. 22-24 IS 1 IF A END OF FILE IS NOT DESIRE	220	
C	ON THE OUTPUT TAPE. 25-27 IS 1 IF THE INPUT TAPE IS NOT TO BE REWOUND	230	
C	28-30 IS 1 IF THE OUTPUT TAPE IS NOT TO BE REWOUND.	240	
C	THE THIRD CARD CONTAINS THE LINE TO BE PRINTED BETWEEN BLOCKS.	250	
C	THE FOURTH CARD CONTAINS THE LINE TO BE PUT AT THE END OF A PAGE.	260	
C	THE FIFTH CARD CONTAINS THE LINE TO BE PUT AT THE END OF THE TABLE	270	
C	THE SIXTH CARD IN 26I3 FORMAT GIVES THE START AND WIDTHS OF THE INPUT	280	
C	FIELDS, IF MORE THAN 13 FIELDS ARE REQUIRED THEY ARE PUT ON ANOTHER	290	
C	CARD. THE NEXT CARD IN 26(I2,A1) FORMAT SPECIFIES THE MAKEUP OF THE	300	
C	OUTPUT CARD OR LINE. THE INPUT AND OUTPUT CAN NOT EXCEED 132 CHARS.	310	
C	THE FOLLOWING SET OF CARDS CONTAIN THE STRINGS TO BE INSERTED. EACH	320	
C	STRING MUST BE TERMINATED BY THE CHARACTER IN COL 80 OF THE FIRST	330	
C	CONTROL CARD. A CARD WITH THAT CHAR IN COL 1 TERMINATES THE READING	340	
C	OF STRINGS. ONLY 26 STRINGS ARE PERMITTED.	350	
C	THE NEXT SET OF CARDS CONTAINS THE FIELDS AND CHARACTERS FOR THE	360	
C	SINGLE CHAR SUBSTITUTION. IN 4I3 FORMAT. THE FIRST FIELD CONTAINS	370	
C	THE COL WHERE SUBS STARTS, THE SECOND FIELD WHERE SUBS ENDS, THE TH	380	
C	RD FIELD IS THE CARD COL OF THE FIRST CONTROL CARD OF THE CHAR TO BE	390	
C	REPLACED, THE FOURTH FIELD IS CARD COL OF CHAR TO BE INSERTED IN PLAC	400	
C	OF THE ORIGINAL CHAR. THE LAST CARD OF THIS SET IS TO HAVE 999 IN THE	410	
C	FIRST FIELD, THIS TERMINATES THE READING OF THIS SET. ONLY 25 CARDS	420	
C	ARE ALLOWED IN THIS SET.	430	
C	THE NEXT CARDS CONTAIN IN SETS OF TWO CARDS THE CHANGES IN OUTPUT	440	
C	REQUIRED IN UP TO 30 DIFFERENT FIELDS. THE FIRST CARD IN 3I3 FORMAT	450	
C	CONTAINS 1 THE FIELD TO BE REPLACED, 2 THE COL THE FLAG IS TO BE IN.	460	
C	3 THE CHAR THAT IS TO ACT AS A FLAG SIGNALING REPLACEMENT. THE	470	
C	SECOND CARD CONTAINS THE STRINGS AND FIELDS TO BE INSERTED IN TH SAME	480	
C	FORMAT AS IN THE CARD SPECIFYING THE OUTPUT. IF THE NUMBER OF FIELD	490	
C	IS 80 OR LESS IT DESIGNATES THE CHARACTER IN THAT CARD COL OF THE	500	
C	FIRST CONTROL CARD. IF IT IS 81 IT DESIGNATES ANY ALPHABETIC CHARACT	510	
C	82 IS ANY NUMERIC CHAR, 83 IS ANY GRAPHIC CHAR, 84 IS ANY NONALPHABET	520	
C	CHAR, 85 IS ANY NONNUMERIC CHAR, 86 IS ANY NONGRAPHIC CHARACTER.	530	
C	THE LAST CARD IN 4I3 FORMAT SPECIFIES THE CONDITION THAT IS TO	540	
C	START A NEW PAGE. COL 1-3 CONTAINS THE STARTING COL. 4-6 CONTAINS	550	
C	THE LAST COL. 7-9 CONTAINS THE NUMBER OF THE STRING TO BE MATCHED.	560	
C	10-12 CONTAINS THE NEW NUMBER THE LINE COUNTER IS TO BE SET TO.	570	
C	TO START A NEW PAGE WITH THE LINE MATCHED, THE NUMBER OF LINES PER	580	
C	PAGE IS PUT IN COL 10-12.	590	
C	IF THE NUMBER INPUT AS THE STARTING COL. IS GREATER THAN 150 THE	600	
C	PROGRAM SKIPS THE CHECK FOR A NEW PAGE.	610	
C		620	
	DIMENSION ISTRT(40), IWIDTH(40), IA(100), ISTRNG(26,80), IR(132)	630	
	DIMENSION IBUFR(135), IRTX(100), IPTX(100), IETX(100), IFNBR(30)	640	
	DIMENSION ISNBR(30), LNGTH(29), IBST(25), IBEN(25), LCAR(25), LREP	650	
	1(25)	660	
	DIMENSION JFNBR(30), JCAR(30), JCOL(30), KFNBR(30,30), KSNBR(30,30)	670	
	1)	680	< B
C	THE NEXT TWO CARDS ARE INSTALLATION DEPENDENT.	690	
	ITAPE=5	700	
	IOTAPE=6	710	
C	INPUT PARAMETER CARDS.	720	
	READ (ITAPE,1140) (IA(J),J=1,80)	730	• C
	WRITE (IOTAPE,1150) (IA(J),J=1,80)	740	
	READ (ITAPE,1160) NFLDS,IRLNG,IBLK,IPAG,IRTAPE,IPTAPE,ITEST,IEND,IS	750	
	1RCK,IPCK	760	

C	THE NEXT TEN CARDS CHECK I/O TAPES AND ARE INSTALLATION DEPENDENT	STR 770
	IF (IRTAPE-5) 10,50,20	STR 780
10	IRTAPE=5	STR 790
	GO TO 50	STR 800
20	IF (IRTAPE-6) 10,10,30	STR 810
30	IF (IRCK) 50,40,50	STR 820
40	REWIND IRTAPE	STR 830
50	IF (IPTAPE-6) 60,90,70	STR 840
60	IPTAPE=3	STR 850
	GO TO 90	STR 860
70	IF (IPCK) 90,80,90	STR 870
80	REWIND IPTAPE	STR 880
90	WRITE (IOTAPE,1170) NFLDS,IRLNG,IBLK,IPAG,IRTAPE,IPTAPE,ITEST,IEND	STR 890
	1,IRCK,IPCK	STR 900
C	INPUT BLOCK AND PAGE SEPARATOR AND END OF JOB CARDS.	STR 910
	READ (ITAPE,1140) (IBTX(J),J=1,80)	STR 920
	WRITE (IOTAPE,1150) (IBTX(J),J=1,80)	STR 930
	READ (ITAPE,1140) (IPTX(J),J=1,80)	STR 940
	WRITE (IOTAPE,1150) (IPTX(J),J=1,80)	STR 950
	READ (ITAPE,1140) (IETX(J),J=1,80)	STR 960
	WRITE (IOTAPE,1150) (IETX(J),J=1,80)	STR 970
C	INPUT FIELD SPECIFICATION CARDS, 40 FIELDS MAXIMUM.	STR 980
	READ (ITAPE,1160) ((ISTR(J),IWIDTH(J)),J=1,NFLDS)	STR 990
	DO 110 J=1,NFLDS	STR1000
	K=J	STR1010
	KLS=J	STR1020
	IF (ISTR(J)) 100,120,100	STR1030
100	IF (IWIDTH(J)) 110,120,110	STR1040
110	CONTINUE	STR1050
	GO TO 130	STR1060
120	WRITE (IOTAPE,1200) NFLDS,K	STR1070
130	WRITE (IOTAPE,1170) ((ISTR(J),IWIDTH(J)),J=1,NFLDS)	STR1080
C	INPUT THE OUTPUT FORMAT CARD, CHECK IF FIELD IS DEFINED.	STR1090
	READ (ITAPE,1180) ((IFNBR(J),ISNBR(J)),J=1,26)	STR1100
	WRITE (IOTAPE,1190) ((IFNBR(J),ISNBR(J)),J=1,26)	STR1110
	DO 140 J=1,26	STR1120
	KK=IFNBR(J)	STR1130
	IF (KK-K) 140,140,150	STR1140
140	CONTINUE	STR1150
	GO TO 160	STR1160
150	WRITE (IOTAPE,1210) KK,K	STR1170
	STOP	STR1180
160	WRITE (IOTAPE,1220)	STR1190
	JJ=1	STR1200
C	INPUT AD HOC STRINGS.	STR1210
170	READ (ITAPE,1140) (ISTRNG(JJ,J),J=1,80)	STR1220
	IF (ISTRNG(JJ,1)-IA(80)) 180,280,180	STR1230
180	K=1	STR1240
190	K=K+1	STR1250
	IF (ISTRNG(JJ,K)-IA(80)) 200,270,200	STR1260
200	IF (K-80) 190,210,210	STR1270
210	DO 220 L=1,80	STR1280
	LE=81-L	STR1290
	IF (ISTRNG(JJ,LE)-IA(47)) 230,220,230	STR1300
220	CONTINUE	STR1310
230	LNGTH(JJ)=LE	STR1320
	K=LE+1	STR1330
	IF (ISTRNG(JJ,LE)-IA(47)) 270,240,270	STR1340
240	WRITE (IOTAPE,1230) JJ	STR1350
	JJ=JJ+1	STR1360
250	IF (JJ-27) 170,170,260	STR1370
260	WRITE (IOTAPE,1240) IA(80)	STR1380
	STOP	STR1390
270	LNGTH(JJ)=K-1	STR1400
	M=K-1	STR1410
	WRITE (IOTAPE,1150) (ISTRNG(JJ,J),J=1,80)	STR1420
	JJ=JJ+1	STR1430
	GO TO 250	STR1440
280	NSTRNG=JJ-1	STR1450
	WRITE (IOTAPE,1250) NSTRNG	STR1460
	K=1	STR1470
	KNTR=0	STR1480
	LINES=0	STR1490
	WRITE (IOTAPE,1260) IRLNG	STR1500
	IF (IRLNG) 300,300,290	STR1510
290	IF (IRLNG-132) 310,310,300	STR1520
300	WRITE (IOTAPE,1270)	STR1530

310	STOP	STR1540
	J=1	STR1550
	WRITE (IOTAPE,1280)	STR1560
	IREP=0	STR1570
C	INPUT SINGLE CHARACTER SUBSTITUTION CARDS.	STR1580
320	READ (ITAPE,1160) IBST(J),IBEN(J),LCAR(J),LREP(J)	STR1590
	IF (IBST(J)-199) 330,340,340	STR1600
330	IREP=J	STR1610
	WRITE (IOTAPE,1170) IBST(J),IBEN(J),LCAR(J),LREP(J)	STR1620
	J=J+1	STR1630
	GO TO 320	STR1640
340	J=J-1	STR1650
	WRITE (IOTAPE,1290) J	STR1660
	L=1	STR1670
	K=KLS	STR1680
C	INPUT FIELD REPLACEMENT SPECIFICATION CARDS.	STR1690
350	READ (ITAPE,1160) JFNBR(L),JCOL(L),JCAR(L)	STR1700
	WRITE (IOTAPE,1170) JFNBR(L),JCOL(L),JCAR(L)	STR1710
	IF (JFNBR(L)-40) 360,360,390	STR1720
360	READ (ITAPE,1180) ((KFNBR(L,K),KSNBR(L,K)),K=1,26)	STR1730
	WRITE (IOTAPE,1190) ((KFNBR(L,K),KSNBR(L,K)),K=1,26)	STR1740
	DO 370 J=1,26	STR1750
	KK=KFNBR(L,K)	STR1760
	IF (KK-K) 370,370,150	STR1770
370	CONTINUE	STR1780
	L=L+1	STR1790
	IF (L-30) 350,350,380	STR1800
380	WRITE (IOTAPE,1130)	STR1810
C	INPUT NEW PAGE SPECIFICATION CARD.	STR1820
C	* NEXT STATEMENT NOT ASA FORTRAN *****	STR1830
390	READ (ITAPE,1160,END=395) MCST,MCEN,MSTRNG,MLINE	STR1840
	GO TO 400	STR1854
395	MCST = 199	STR1858
	WRITE (IOTAPE,1170) MCST,MCEN,MSTRNG,MLINE	STR1850
C	START PROCESSING RECORDS.	STR1860
C	INPUT A RECORD.	STR1870
C	* NEXT STATEMENT NOT ASA FORTRAN *****	STR1880
400	READ (IRTAPE,1140,END=1070) (IR(J),J=1,IRLNG)	STR1890
	L=1	STR1900
C	CHECK FOR END BY PARAMETER CARD	STR1910
	DO 410 J=1,26	STR1920
	IF (IB(J)-IA(J)) 420,410,420	STR1930
410	CONTINUE	STR1940
	GO TO 1070	STR1950
420	I=1	STR1960
	IF (IBLK) 450,450,430	STR1970
C	CHECK FOR BLANK LINE, IF BLANK READ NEW LINE	STR1980
430	DO 440 J=1,IRLNG	STR1990
	IF (IB(J)-IA(47)) 450,440,450	STR2000
440	CONTINUE	STR2010
	GO TO 400	STR2020
450	IF (MCST-150) 460,480,480	STR2030
460	K=0	STR2040
	DO 470 J=MCST,MCEN	STR2050
	K=K+1	STR2060
	IF (IR(J)-ISTRNG(MSTRNG,K)) 480,470,480	STR2070
470	CONTINUE	STR2080
	LINES=MLINE	STR2090
480	IF (IREP) 520,520,490	STR2100
C	START CHARACTER SUBSTITUTION BY FIELDS	STR2110
490	DO 510 J=1,IREP	STR2120
	LC=LCAR(J)	STR2130
	LR=LREP(J)	STR2140
	LS=IBST(J)	STR2150
	LE=IREN(J)	STR2160
	DO 510 K=LS,LE	STR2170
	IF (IA(LC)-IB(K)) 510,500,510	STR2180
500	IB(K)=IA(LR)	STR2190
510	CONTINUE	STR2200
C	BUILD A NEW RECORD FROM OLD RECORD AND AD HOC STRINGS.	STR2210
520	N=IFNBR(I)	STR2220
	IF (N) 530,550,530	STR2230
530	NN=ISTRN(N)	STR2240
	DO 540 J=NN,NX	STR2260
	KNTR=KNTR+1	STR2270
	IF (KNTR-132) 540,540,1120	STR2280 • E
540	IBUFR(KNTR)=IB(J)	STR2290

550	IF (ISNBR(I)-IA(47)) 560,610,560	STB2300
560	N=ISNBR(I)	STB2310
	DO 580 J=1,26	STB2320
	IF (N-IA(J)) 580,570,580	STB2330
570	M=J	STB2340
	GO TO 590	STB2350
580	CONTINUE	STR2360
	GO TO 610	STR2370
590	N=LNTH(M)	STB2380
	DO 600 J=1,N	STR2390
	KNTR=KNTR+1	STB2400
	IF (KNTR-132) 600,600,1120	STB2410 • F
600	IBUFR(KNTR)=ISTRNG(M,J)	STB2420
610	I=I+1	STR2430
	IF (IFNBR(I)) 620,940,620	STB2440
620	IF (IFNBR(I)-JFNBR(L)) 520,640,630	STR2450
630	IF (L-30) 930,520,520	STB2460
C	CHECK TO SEE IF FIELD REPLACEMENT IS REQUIRED.	STB2470
640	LCO=JCOL(L)	STR2480
	IF (JCAR(L)-81) 650,660,680	STR2490
650	LCA=JCAR(L)	STB2500
	IF (IA(LCA)-IB(LCO)) 810,820,810	STR2510
660	DO 670 J=1,26	STB2520
	IF (IB(LCO)-IA(J)) 670,820,670	STR2530
670	CONTINUE	STB2540
	GO TO 810	STR2550
680	IF (JCAR(L)-83) 690,710,740	STR2560
690	DO 700 J=27,36	STB2570
	IF (IB(LCO)-IA(J)) 700,820,700	STR2580
700	CONTINUE	STR2590
	GO TO 810	STB2600
710	IF (IB(LCO)-IA(47)) 720,810,720	STR2610
720	DO 730 J=1,36	STR2620
	IF (IB(LCO)-IA(J)) 730,810,730	STR2630
730	CONTINUE	STR2640
	GO TO 820	STR2650
740	IF (JCAR(L)-85) 750,770,790	STR2660
750	DO 760 J=1,26	STR2670
	IF (IB(LCO)-IA(J)) 760,810,760	STB2680
760	CONTINUE	STR2690
	GO TO 820	STR2700
770	DO 780 J=27,36	STR2710
	IF (IB(LCO)-IA(J)) 780,810,780	STR2720
780	CONTINUE	STR2730
	GO TO 820	STR2740
790	DO 800 J=1,36	STR2750
	IF (IB(LCO)-IA(J)) 800,810,800	STB2760
800	CONTINUE	STR2770
	GO TO 820	STR2780
810	L=L+1	STR2790
	GO TO 620	STB2800
C	REPLACE FIELD BY NEW FORMAT.	STR2810
820	K=1	STB2820
830	N=KFNB(R(L,K))	STR2830
	IF (N) 840,860,840	STR2840
840	NN=ISTRN(N)	STR2850
	NX=NN+IWIDTH(N)-1	STR2860
	DO 850 J=NN,NX	STR2870
	KNTR=KNTR+1	STR2880
	IF (KNTR-132) 850,850,1120	STR2890 • G
850	IBUFR(KNTR)=IB(J)	STR2900
860	IF (KSNBR(L,K)-IA(47)) 870,910,870	STR2910
870	N=KSNBR(L,K)	STR2920
	DO 880 J=1,26	STR2930
	IF (N-IA(J)) 880,890,880	STR2940
880	CONTINUE	STR2950
	GO TO 910	STR2960
890	M=J	STR2970
	N=LNTH(M)	STR2980
	DO 900 J=1,N	STR2990
	KNTR=KNTR+1	STR3000
	IF (KNTR-132) 900,900,1120	STR3010 • H
900	IBUFR(KNTR)=ISTRNG(M,J)	STR3020
910	K=K+1	STR3030
	IF (KFNB(R(L,K)) 830,920,830	STR3040
920	L=L+1	STR3050

GO TO 550	STR3060
C CHECK FOR END OF BLOCK AND END OF PAGE.	STR3070
930 L=L+1	STR3080
GO TO 620	STR3090
940 WRITE (IPTAPE,1140) (IBUFR(JX),JX=1,KNTR)	STR3100
IF (ITEST) 960,950,960	STR3110
950 WRITE (IOTAPE,1150) (IBUFR(JX),JX=1,KNTR)	STR3120
960 KNTR=0	STR3130
LINES=LINES+1	STR3140
IF (LINES) 400,1010,970	STR3150
970 IF (IBLK) 400,400,980	STR3160
980 IF (IRLK*(LINES/IBLK)-LINES) 400,990,400	STR3170
990 IF (IPAG) 1010,1010,1000	STR3180
1000 IF (IPAG*(LINES/IPAG)-LINES) 1010,1040,1010	STR3190
1010 WRITE (IPTAPE,1140) (IBTX(J),J=1,80)	STR3200
IF (ITEST) 1030,1020,1030	STR3210
1020 WRITE (IOTAPE,1150) (IBTX(J),J=1,80)	STR3220
1030 GO TO 400	STR3230
1040 WRITE (IPTAPE,1140) (IPTX(J),J=1,80)	STR3240
IF (ITEST) 1060,1050,1060	STR3250
1050 WRITE (IOTAPE,1150) (IPTX(J),J=1,80)	STR3260
1060 GO TO 400	STR3270
C END LAST PAGE	STR3280
1070 WRITE (IPTAPE,1140) (IETX(J),J=1,80)	STR3290
IF (ITEST) 1090,1080,1090	STR3300
1080 WRITE (IOTAPE,1150) (IETX(J),J=1,80)	STR3310
1090 IF (IFND) 1110,1100,1110	STR3320
1100 END FILE IPTAPE	STR3330
WRITE (IOTAPE,1150) IA(47),IA(5),IA(15),IA(6)	STR3340
1110 STOP	STR3350
1120 WRITE (IOTAPE,1300)	STR3360
STOP	STR3370
C	STR3380
C	STR3390
C	STR3400
1130 FORMAT (79H ONLY 30 FIELD SUBSTITUTIONS ARE PERMITTED. THE ABOVE	STR3410
1 WAS THE 31ST SPECIFIED.)	STR3420
1140 FORMAT (132A1)	STR3430
1150 FORMAT (1X,131A1)	STR3440
1160 FORMAT (26I3)	STR3450
1170 FORMAT (1X,26I3)	STR3460
1180 FORMAT (26(I2,A1))	STR3470
1190 FORMAT (1X,26(I2,A1))	STR3480
1200 FORMAT (20H YOU HAVE SPECIFIED,114,26H FIELDS, BUT DEFINED ONLY ,	STR3490
1114)	STR3500
1210 FORMAT (26H YOU HAVE REQUESTED FIELD,113,26H THE LAST DEFINED FIESTR	STR3510
1LD IS,1I3)	STR3520
1220 FORMAT (18H THE STRINGS ARE)	STR3530
1230 FORMAT (11H *** STRING,1I3,13H IS BLANK. \$\$)	STR3540
1240 FORMAT (82H *** YOU HAVE MORE THAN 26 STRINGS OR YOU FORGOT TO ENDSTR	STR3550
1 THE LIST OF STRINGS WITH A,1A1,10H IN COL. 1)	STR3560
1250 FORMAT (11H THERE ARE,1I3,9H STRINGS)	STR3570
1260 FORMAT (26H THE LENGTH OF RECORD IS ,1I5)	STR3580
1270 FORMAT (83H *** THE PROGRAM CAN NOT READ RECORDS SHORTER THAN 1 ORSTR	STR3590
1 LONGER THAN 132 CHARACTERS.)	STR3600
1280 FORMAT (28H THE SUBSTITUTION CARDS ARE)	STR3610
1290 FORMAT (12H THERE ARE ,1I3,20H SUBSTITUTION CARDS.)	STR3620
1300 FORMAT (73H *** YOU ARE TRYING TO WRITE RECORDS OF MORE THAN 132	STR3630
1CHARACTERS. STOP.)	STR3640
END	STR3650-

I

J

APPENDIX II

This Appendix shows how the program in Appendix I was modified to provide blocked output from the NBS computer. The subroutine used to take advantage of the buffered tape write is also listed. These changes should also serve as a guide for modifying the program for other systems.

C TO END THE STRINGS. COL 78 IS USED TO FILL THE LAST RECORD OUTPUT. STB 140 • A

```
COMMON /A/ ITAPE,IOTAPE,IW,ITEST,ICLK,NSTAB,TABNO,IEND
COMMON /B/ IAT(100),IE(750)
COMMON /G/ IBLEN,IBFR(3000)
COMMON /H/ IPTAPE,IOUT
EQUIVALENCE (IBFR(1),IBUFR(1)),(IAT(1),IA(1))
IOUT = 1998
IBLEN = 2995
ICLK = 1
CALL INPACK(1)
```

STB 681
STB 682
STB 683
STB 684
STB 685
STB 686
STB 687
STB 688
STB 689

B

READ (ITAPE,1140,END=1100) (IA(J),J=1,80)

STB 730 • C

```
DO 1500 J = 1,80
K = 81-J
IF (IATX(K) - IA(47)) 1510,1500,1510
1500 JBTX = K
1510 DO 1530 J = 1,80
K = 81-J
IF (IPTX(K) - IA(47)) 1540,1530,1540
1530 JPTX = K
1540 DO 1560 J = 1,80
K = 81-J
IF (IETX(K) - IA(47)) 1570,1560,1570
1560 JETX = K
1570 CONTINUE
```

STB 971
STB 972
STB 973
STB 974
STB 975
STB 9755
STB 976
STB 9765
STB 977
STB 9775
STB 978
STB 9785
STB 979

D

IF (KNTR-2900) 540,540,1120

STB2280 • E

IF (KNTR-2900) 600,600,1120

STB2410 • F

IF (KNTR-2900) 850,850,1120

STB2890 • G

IF (KNTR-2900) 900,900,1120

STB3010 • H

```
940 IW = KNTR
CALL REPACK (IWRT,IKOWT)
945 IEND = 0
IF (ICLK) 960,960,950
```

STB3100
STB3105
STB3108
STB3110

I

```
1010 IW = JBTX
DO 1020 J = 1,JBTX
1020 IBUFR(J) = IBTX(J)
CALL REPACK (IWRT,IKOWT)
1030 GO TO 400
1040 IW = JPTX
DO 1050 J = 1,JPTX
1050 IBUFR(J) = IPTX(J)
CALL REPACK (IWRT,IKOWT)
1060 GO TO 400
C END LAST PAGE
```

STB3200
STB3210
STB3215
STB3220
STB3230
STB3235
STB3240
STB3250
STB3260
STB3270
STB3280

```
1070 IW = JETX
DO 1080 J=1,JETX
1080 IBUFR(J) = IETX(J)
CALL REPACK (IWRT,IKOWT)
IF (IKOWT - IOUT) 1094,1094,1097
1094 JOT = IOUT - IKOWT + 2
DO 1095 J = 1,JOT
IBUFR(J) = IA(78)
IW = J
```

STB3282
STB3284
STB3286
STB3288
STB3290
STB3294
STB3298
STB3300
STB3302

J

```
IF (J-2000) 1095,1095,1096
1095 CONTINUE
1096 CALL REPACK (IWRT,IKOWT)
IF (IKOWT - IOUT) 1094,1097,1097
1097 IF (IWRT) 1098,1098,1090
1098 IF (IWRT + 2) 1099,1099,1097
1099 WRITE (IOTAPE,1600) IWRT
1600 FORMAT (44H NTRAN WRITE ERROR ON LAST RECORD. STATUS = ,I5)
1090 IF (IEND) 1110,1100,1110
```

STB3304
STB3306
STB3308
STB3310
STB3312
STB3314
STB3316
STB3318
STB3320

QIT FOR REPAK,REPAK		
	SUBROUTINE INPACK (IK)	
	COMMON /A/ ITAPE,IOTAPE,ICHAR,ITEST,ICLK,NSTAR,TABNO,IEND	RPC 20
	COMMON /B/ IA(100),IE(750)	RPC 30
	COMMON /G/ IBLEN,ISTRIN(3000)	RPC 40
	COMMON /H/ IPTAPE,IOUT	RPC 50
	DIMENSION IWORDS(1000)	RPC 60
	K=IK	RPC 70
	IOPT=IOUT/6	RPC 80
	IF (IOUT-6*IOPT) 10,20,10	RPC 90
10	WRITE (IOTAPE,230) IOUT	RPC 100
	STOP	RPC 110
20	RETURN	RPC 120
	ENTRY REPACK (IWRT,IKOWT)	RPC 130
30	IF (IWRT) 40,60,60	RPC 140
40	IF (IWRT+2) 50,50,30	RPC 150
50	WRITE (IOTAPE,240) IWRT	RPC 160
60	IF (K-IOUT-1) 150,90,70	RPC 170
70	K1=1	RPC 180
	K2=K/6+1	RPC 190
	K3=IOPT+1	RPC 200
	DO 80 J=K3,K2	RPC 210
	IWORDS(K1)=IWORDS(J)	RPC 220
80	K1=K1+1	RPC 230
90	K=K-IOUT	RPC 240
	IF (K-IOUT-1) 150,100,100	RPC 250
100	CALL NTRAN (IPTAPE,1,IOPT,IWORDS,IWRT)	RPC 260
	IF (ITEST) 110,30,110	RPC 270
110	DO 140 I=1,IOPT,21	RPC 280
	J=I+20	RPC 290
	IF (J-IOPT) 130,130,120	RPC 300
120	J=IOPT	RPC 310
130	WRITE (IOTAPE,250) (IWORDS(L),L=I,J)	RPC 320
140	CONTINUE	RPC 330
	NREC=NREC+1	RPC 340
	WRITE (IOTAPE,260) NREC,IOUT,ICHAR,IOPT,K	RPC 350
	GO TO 30	RPC 360
150	DO 160 I=1,ICHAR	RPC 370
	IK=I+K-1	RPC 380
	J=IK-((IK-1)/6)*6	RPC 390
	IZ=(IK-1)/6+1	RPC 400
	FLD(6*(J-1),6,IWORDS(IZ))=FLD(0,6,ISTRIN(I))	RPC 410
160	CONTINUE	RPC 420
	K=K+ICHAR	RPC 430
	IKOWT=K	RPC 440
	IF (K-IOUT-1) 220,170,170	RPC 450
170	CALL NTRAN (IPTAPE,1,IOPT,IWORDS,IWRT)	RPC 460
	IF (ITEST) 180,220,180	RPC 470
180	DO 210 I=1,IOPT,21	RPC 480
	J=I+20	RPC 490
	IF (J-IOPT) 200,200,190	RPC 500
190	J=IOPT	RPC 510
200	WRITE (IOTAPE,250) (IWORDS(L),L=I,J)	RPC 520
210	CONTINUE	-PC 530
	NREC=NREC+1	RPC 540
	WRITE (IOTAPE,260) NREC,IOUT,ICHAR,IOPT,K	RPC 550
220	RETURN	RPC 560
C		RPC 570
	230 FORMAT (1X,44H OUTPUT WIDTH NOT AN EVEN NUMBER OF WORDS = ,116)	
	240 FORMAT (29H NTRAN WRITE ERROR. STATUS = ,114)	
250	FORMAT (1X,21A6)	RPC 600
260	FORMAT (17H ABOVE IS RECORD,115,6H IT IS,115,17H CHARACTERS LONG,-	-PC 610
	1,6I10)	RPC 620
	END	RPC 630-

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